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Dynamical diffraction at high intensities

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Proposal number: L562

Proposal Title: Dynamical diffraction at high intensities

Date of experiment: 7/12 to 7/16, 2012

Instrument used: CXI

Brief summary:

Experiment: Our goal was to use LCLS pulses to measure Bragg and Laue diffraction on *single-crystal* silicon. Multiple technical difficulties (described below) required us to redirected the experiment and measure the high-intensity Bragg reflection off *polycrystalline* silicon, instead: we used a series of LCLS shots to alter the local crystalline state of the sample into smaller domains, and monitored Bragg reflection as a function of x-ray fluence and shot number. Fig.1 shows the Bragg-signal intensity as a function of shot number and for different fluences.

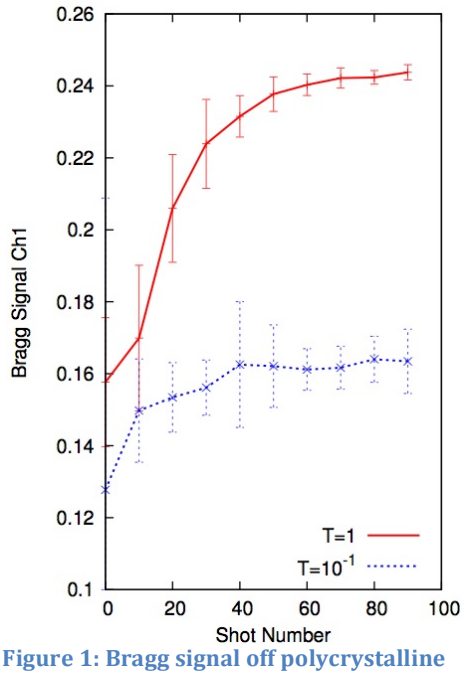

Figure 1: Bragg signal off polycrystalline silicon as a function of shot number. T is the x-ray transmission.

Current status of data analysis: Data analysis for this experiment is still ongoing. Our efforts are currently focusing on performing *post-mortem* sample analysis; we plan on characterizing the local morphology, crystal structure and possibly electronic structure of the sample near craters. This will help us better understand the process leading to the formation of nanocrystals in the sample.

Issues: The relatively complex setup was co-developed by LCLS and LLNL, with the CCD hardware provided by the users, and all DAQ and most diode hardware by LCLS. The diode deployed to measure the Bragg signal did not work as anticipated, while the CCD controller used for the Laue signal got damaged by the server computer and failed to give any readout. Additionally, severe cracking on the sample surface was observed at high x-ray fluences, making sample alignment challenging.

Successful: Yes, after redirecting the experiment; data analysis and post-mortem inspection are still ongoing.

Dissemination of results:

Preliminary results have been discussed:

1. S. P. Hau-Riege, Center for Adaptive Optics Fall retreat, 2012, Lake Arrowhead CA (invited)
2. S. P. Hau-Riege, SLAC Seminar 2012, Menlo Park CA (invited)

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